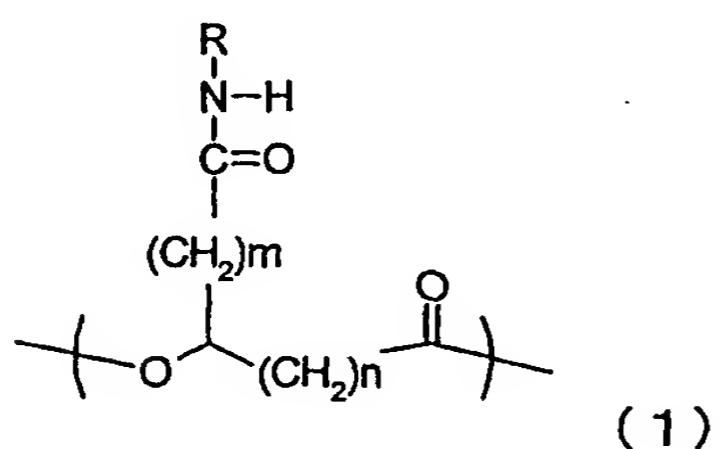


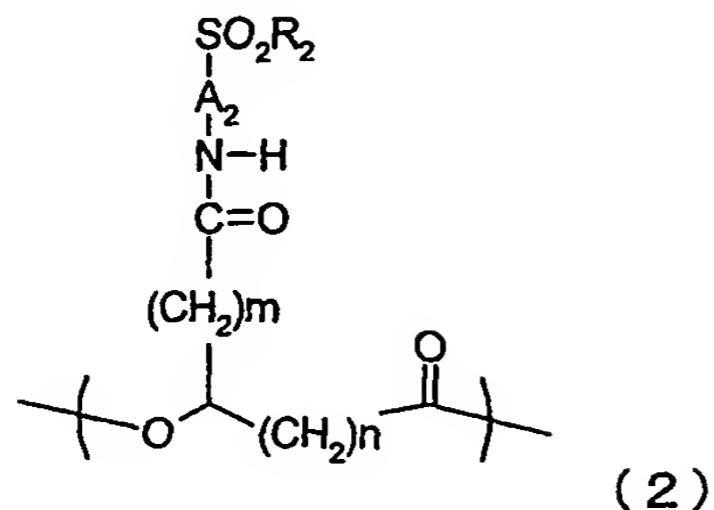
CLAIMS

1. Polyhydroxyalkanoate comprised of at least a unit represented by a chemical formula (1) within the
5 molecule:

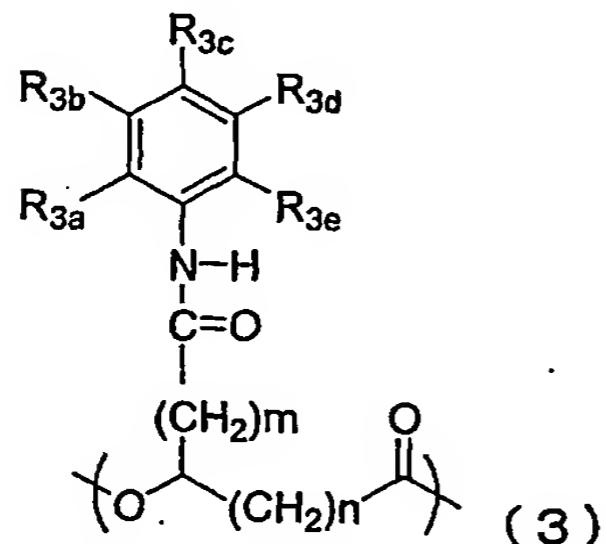


wherein R represents $-A_1-SO_2R_1$; R_1 represents OH, a halogen atom, ONa, OK or OR_{1a}; R_{1a} and A₁ each independently represents a group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure or a substituted or unsubstituted heterocyclic structure; n represents an integer selected from 0 to 10; m represents an integer selected from 0 - 8 in case n is 0, 2, 3 or 4, and m represents 0 in case n is 1; and in case plural units are present, R, R₁, R_{1a}, A₁, m and n have the aforementioned meanings independently for each unit.

2. Polyhydroxyalkanoate according to claim 1,
20 comprised of, as the unit represented by the chemical formula (1), at least a unit represented by a chemical formula (2), a chemical formula (3), a chemical formula (4A) or (4B), within the molecule:

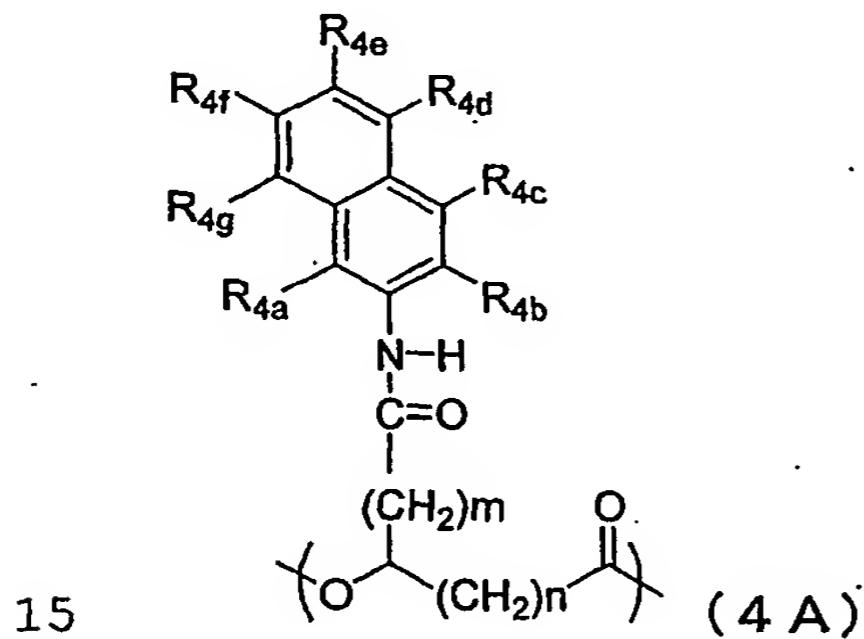


wherein R_2 represents OH , a halogen atom, ONa , OK or OR_{2a} ; R_{2a} represents a linear or branched alkyl group with 1 to 8 carbon atoms or a substituted or 5 unsubstituted phenyl group, A_2 represents a linear or branched alkylene group with 1 to 8 carbon atoms; n represents an integer selected from 0 to 4; m represents an integer selected from 0 - 8 in case n is 0, 2, 3 or 4, and m represents 0 in case n is 1; 10 and in case plural units are present, A_2 , R_2 , R_{2a} , m and n have the aforementioned meanings independently for each unit;



wherein R_{3a} , R_{3b} , R_{3c} , R_{3d} and R_{3e} each independently 15 represents SO_2R_{3f} (R_{3f} representing OH , a halogen atom, ONa , OK or OR_{3f1} (R_{3f1} representing a linear or branched alkyl group with 1 to 8 carbon atoms or a substituted

or unsubstituted phenyl group)), a hydrogen atom, a halogen atom, an alkyl group with 1 - 20 carbon atoms, an alkoxy group with 1 - 20 carbon atoms, an OH group, an NH₂ group, an NO₂ group, COOR_{3g} (R_{3g} representing a 5 H atom, a Na atom or a K atom), an acetamide group, an OPh group, a NHPh group, a CF₃ group, a C₂F₅ group or a C₃F₇ group (Ph indicating a phenyl group), of which at least one is SO₂R_{3f}; n represents an integer selected from 0 to 4; m represents an integer 10 selected from 0 - 8 in case n is 0, 2, 3 or 4, and m represents 0 in case n is 1; and in case plural units are present, R_{3a}, R_{3b}, R_{3c}, R_{3d}, R_{3e}, R_{3f}, R_{3f1}, R_{3g}, m and n have the aforementioned meanings independently for each unit;

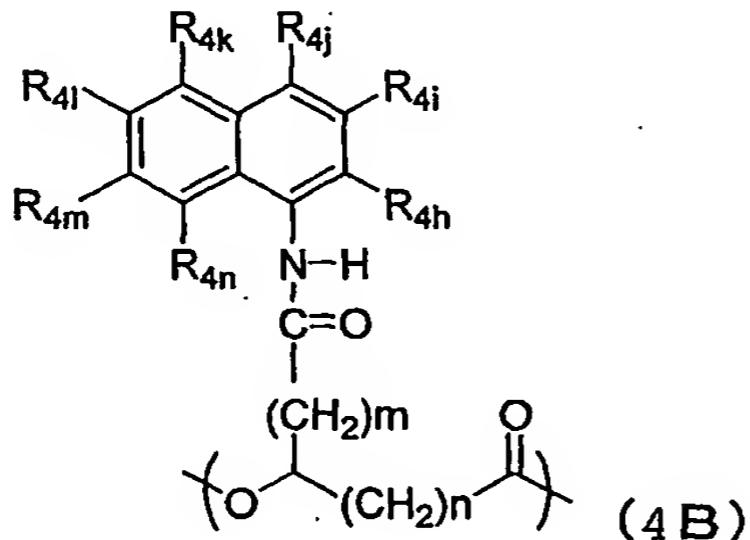


wherein R_{4a}, R_{4b}, R_{4c}, R_{4d}, R_{4e}, R_{4f} and R_{4g} each independently represents SO₂R_{4o} (R_{4o} representing OH, a halogen atom, ONa, OK or OR_{4o1} (R_{4o1} representing a linear or branched alkyl group with 1 to 8 carbon. 20 atoms or a substituted or unsubstituted phenyl group)), a hydrogen atom, a halogen atom, an alkyl

group with 1 - 20 carbon atoms, an alkoxy group with 1 - 20 carbon atoms, an OH group, an NH₂ group, an NO₂ group, COOR_{4p} (R_{4p} representing a H atom, a Na atom or a K atom), an acetamide group, an OPh group, an NHPh group, a CF₃ group, a C₂F₅ group or a C₃F₇ group (Ph indicating a phenyl group), of which at least one is SO₂R_{4o}; n represents an integer selected from 0 to 4; m represents an integer selected from 0 - 8 in case n is 0, 2, 3 or 4, and m represents 0 in case n is 1;

5 and in case plural units are present, R_{4a}, R_{4b}, R_{4c}, R_{4d}, R_{4e}, R_{4f}, R_{4g}, R_{4o}, R_{4o1}, R_{4p}, m and n have the aforementioned meanings independently for each unit;

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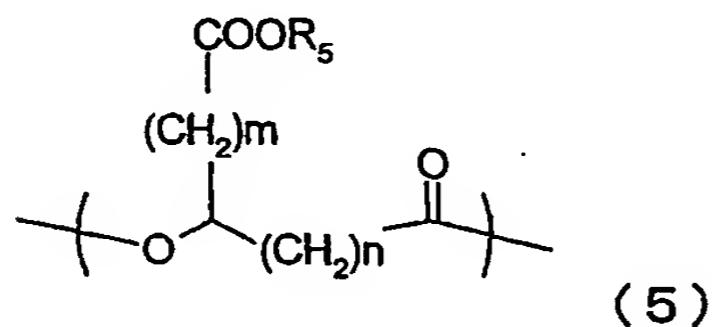
wherein R_{4h}, R_{4i}, R_{4j}, R_{4k}, R_{4l}, R_{4m} and R_{4n} each 15 independently represents SO₂R_{4o} (R_{4o} representing OH, a halogen atom, ONa, OK or OR_{4o1} (R_{4o1} representing a linear or branched alkyl group with 1 to 8 carbon atoms or a substituted or unsubstituted phenyl group)), a hydrogen atom, a halogen atom, an alkyl group with 1 - 20 carbon atoms, an alkoxy group with 1 - 20 carbon atoms, an OH group, an NH₂ group, an NO₂ group, COOR_{4p} (R_{4p} representing a H atom, a Na atom or

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a K atom), an acetamide group, an OPh group, an NHPh group, a CF₃ group, a C₂F₅ group or a C₃F₇ group (Ph indicating a phenyl group), of which at least one is S₀R₄₀; n represents an integer selected from 0 to 4;

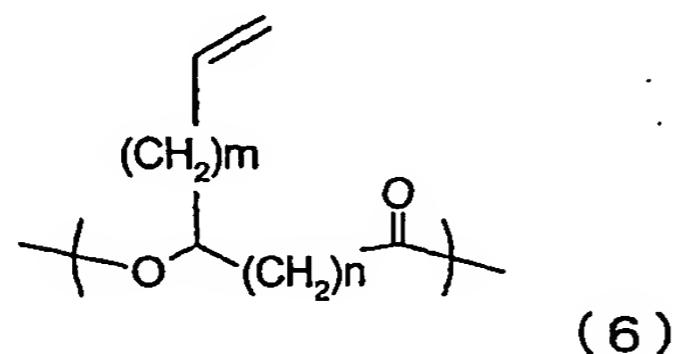
5 m represents an integer selected from 0 - 8 in case n is 0, 2, 3 or 4, and m represents 0 in case n is 1; and in case plural units are present, R_{4h}, R_{4i}, R_{4j}, R_{4k}, R_{4l}, R_{4m}, R_{4n}, R_{4o}, R_{4p}, m and n have the aforementioned meanings independently for each unit.

10 3. Polyhydroxyalkanoate comprised of at least a unit represented by a chemical formula (5) within the molecule:



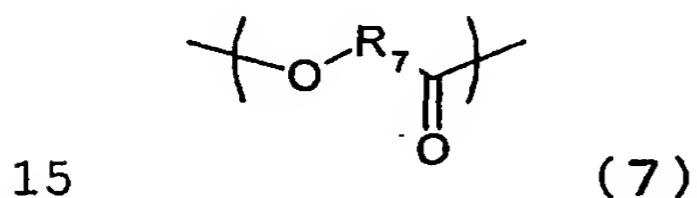
wherein R₅ represents hydrogen, a group capable of
15 forming a salt or R_{5a}; R_{5a} represents a linear or branched alkyl group with 1 - 12 carbon atoms, an aralkyl group or a substituent having a sugar; n represents an integer selected from 0, 2, 3, 4; m represents an integer selected from 2 - 8 in case n is 0, wherein R₅ represents R_{5a} only in case m is 2, and m represents an integer selected from 0 - 8 in case n is an integer selected from 2 - 4; and in case plural units are present, R₅, R_{5a}, m and n have the aforementioned meanings independently for each unit.

4. Polyhydroxyalkanoate comprised of at least a unit represented by a chemical formula (6) within the molecule:



5 wherein n represents an integer selected from 0, 2, 3, 4; m represents an integer selected from 2 - 8 in case n is 0; m represents an integer selected from 0 - 8 in case n is 2 or 3, and m represents an integer selected from 0 and 2 - 8 in case n is 4; and in case
10 plural units are present, m and n have the aforementioned meanings independently for each unit.

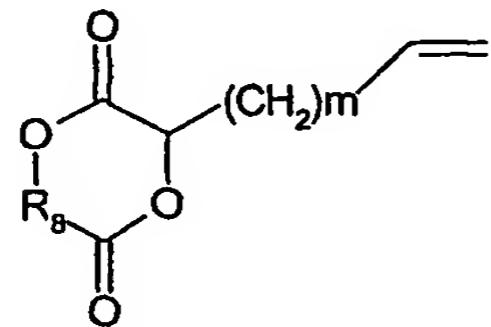
5. Polyhydroxyalkanoate according to any one of claims 1 to 4, further comprising a unit represented by a chemical formula (7) within the molecule:



15 wherein R₇ represents a linear or branched alkylene with 1 - 11 carbon atoms, alkyleneoxyalkylene group (each alkylene group being independently with 1 - 2 carbon atoms), a linear or branched alkenyl group with 1 - 11 carbon atoms or an alkylidene group with 1 - 5 carbon atoms which is unsubstituted or substituted with an aryl group; and in case plural

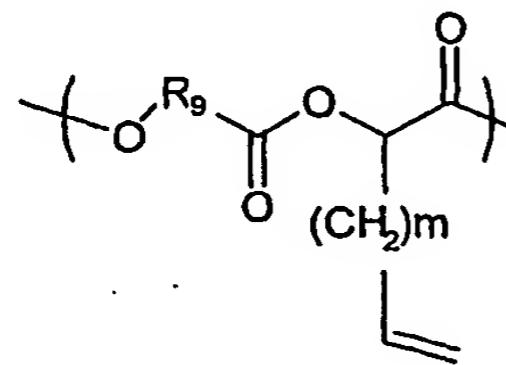
units are present, R₇ has the aforementioned meanings independently for each unit.

6. A method for producing polyhydroxyalkanoate represented by a chemical formula (9), comprised of a
5 step of polymerizing a compound represented by a chemical formula (8) in the presence of a catalyst:



(8)

wherein R₈ represents a linear or branched alkylene with 1 - 11 carbon atoms, alkyleneoxyalkylene group
10 (each alkylene group being independently with 1 - 2 carbon atoms), a linear or branched alkenyl group with 1 - 11 carbon atoms or an alkylidene group with 1 - 5 carbon atoms which is unsubstituted or substituted with an aryl group; and m represents an
15 integer selected from 2 - 8;

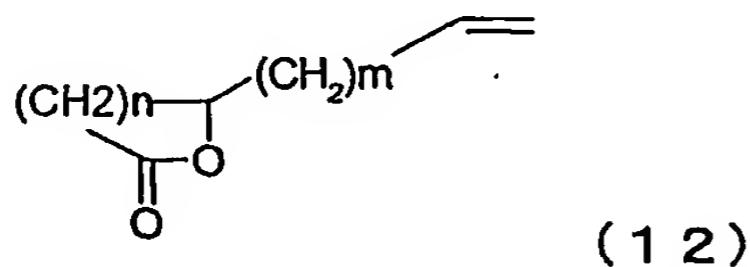


(9)

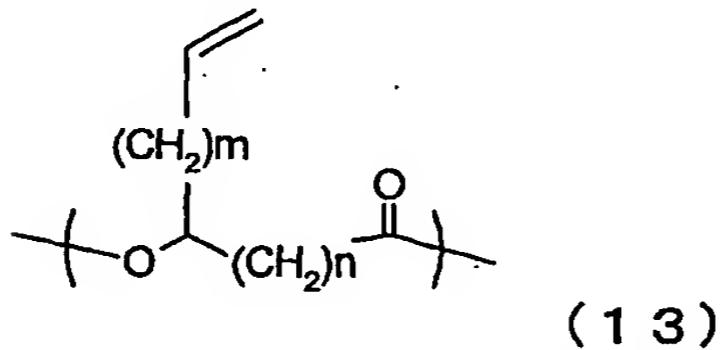
wherein R₉ represents a linear or branched alkylene or alkyleneoxyalkylene group with 1 - 11 carbon atoms (each alkylene group being independently with 1 - 2 carbon atoms), a linear or branched alkenyl group
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with 1 - 11 carbon atoms or an alkylidene group with 1 - 5 carbon atoms which is unsubstituted or substituted with an aryl group; m represents an integer selected from 2 - 8; and in case plural units 5 are present, R₉ and m have the aforementioned meanings independently for each unit.

7. A method for producing polyhydroxyalkanoate represented by a chemical formula (13), comprised of a step of polymerizing a compound represented by a 10 chemical formula (12) in the presence of a catalyst:

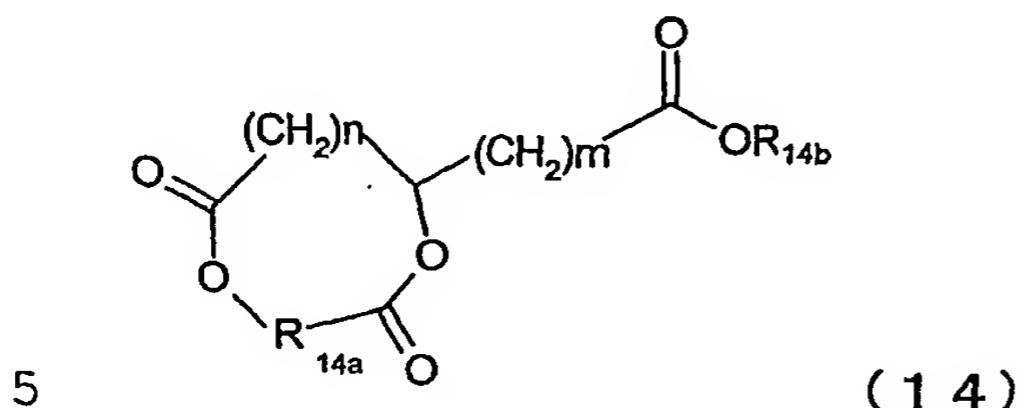


wherein n represents an integer selected from 2 to 4; m represents an integer selected from 0 - 8 in case n is 2 or 3, and m represents an integer selected from 15 0 and 2 - 8 in case n is 4:

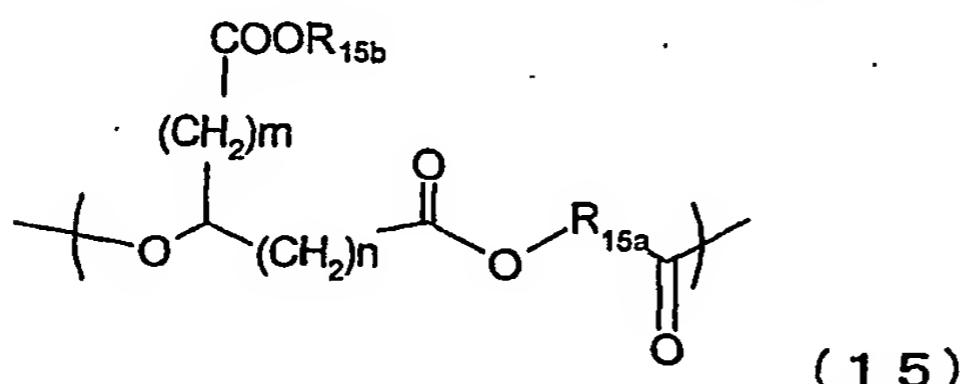


wherein n represents an integer selected from 2 to 4; m represents an integer selected from 0 - 8 in case n is 2 or 3, and m represents an integer selected from 20 0 and 2 - 8 in case n is 4, and in case plural units are present, m and n have the aforementioned meanings independently for each unit.

8. A method for producing polyhydroxyalkanoate represented by a chemical formula (15), comprised of a step of polymerizing a compound represented by a chemical formula (14) in the presence of a catalyst:



wherein R_{14a} represents a linear or branched alkylene with 1 - 11 carbon atoms, alkyleneoxyalkylene group (each alkylene group being independently with 1 - 2 carbon atoms), a linear or branched alkenyl group with 1 - 11 carbon atoms or an alkylidene group with 1 - 5 carbon atoms which is unsubstituted or substituted with an aryl group; R_{14b} represents a linear or branched alkyl group with 1 - 12 carbon atoms or an aralkyl group; n represents an integer selected from 0, 2, 3 and 4; m represents an integer selected from 2 - 8 in case n is 0 and an integer selected from 0 - 8 in case n is selected from 2 - 4;



wherein R_{15a} represents a linear or branched alkylene with 1 - 11 carbon atoms, alkyleneoxyalkylene group

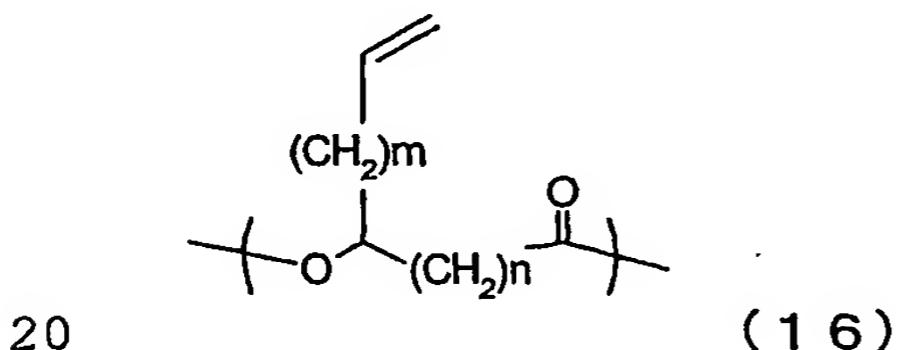
(each alkylene group being independently with 1 - 2 carbon atoms), a linear or branched alkenyl group with 1 - 11 carbon atoms or an alkylidene group with 1 - 5 carbon atoms which is unsubstituted or

5 substituted with an aryl group; R_{15b} represents a linear or branched alkyl with 1 - 12 carbon atoms or an aralkyl group; n represents an integer selected from 0, 2, 3 and 4; m represents an integer selected from 2 - 8 in case n is 0 and an integer selected

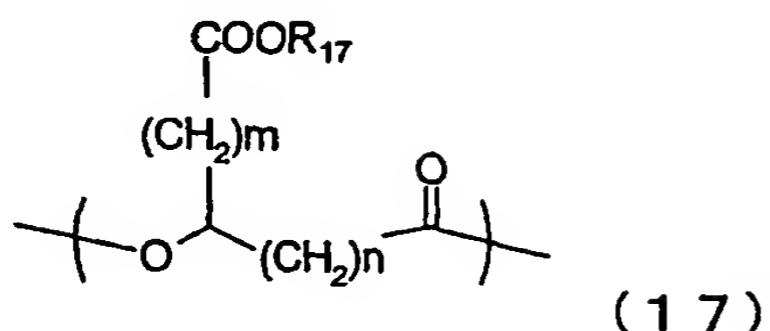
10 from 0 - 8 in case n is selected from 2 - 4; and in case plural units are present, R_{15a}, R_{15b}, m and n have the aforementioned meanings independently for each unit.

9. A method for producing a

15 polyhydroxyalkanoate comprising a unit represented by a chemical formula (17), comprised of a step of oxidizing a double bond portion of a polyhydroxyalkanoate comprising a unit represented by a chemical formula (16):

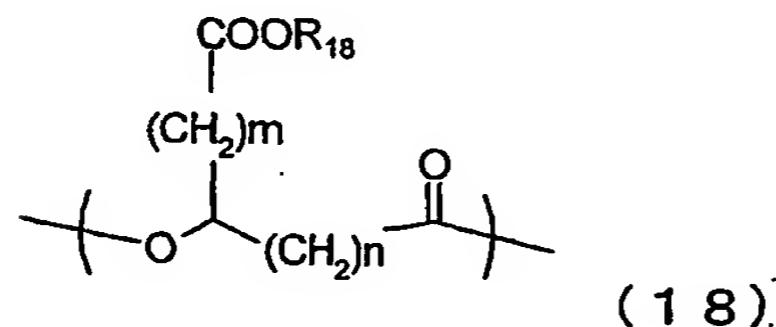


20 wherein m represents an integer selected from 0 - 8; n represents 0, 2, 3 or 4; and, in case plural units are present, m and n have the aforementioned meanings independently for each unit:



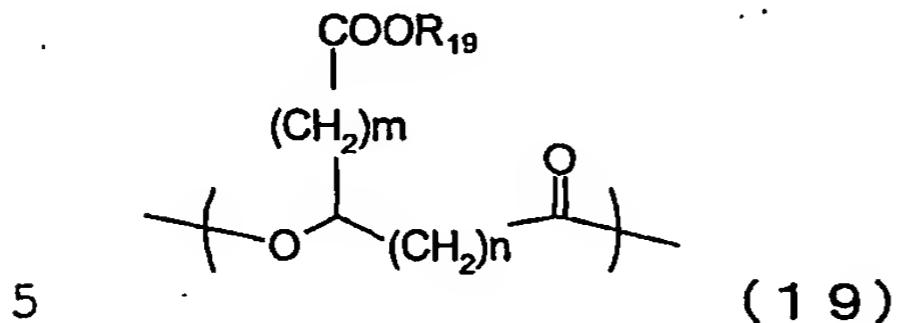
wherein m represents an integer selected from 0 - 8; R₁₇ represents hydrogen, or a group capable of forming a salt; n represents 0, 2, 3 or 4; and, in case plural units are present, m, n and R₁₇ have the aforementioned meanings independently for each unit.

10. A method for producing a polyhydroxyalkanoate comprising a unit represented by a chemical formula (19), comprised of a step of
 10 executing hydrolysis of a polyhydroxyalkanoate comprising a unit represented by a chemical formula (18) in the presence of an acid or an alkali, or a step of executing hydrogenolysis comprising a catalytic reduction of a polyhydroxyalkanoate
 15 comprising a unit represented by a chemical formula (18):



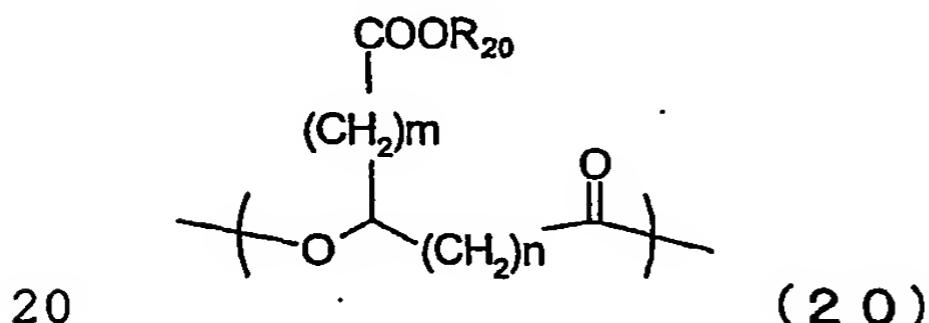
wherein R₁₈ represents a linear or branched alkyl group with 1 - 12 carbon atoms or an aralkyl group; n
 20 represents an integer selected from 0, 2, 3 and 4; m represents an integer selected from 2 - 8 in case n

is 0, or an integer selected from 0 - 8 in case n is 2, 3 or 4; and in case plural units are present, R₁₉, m and n have the aforementioned meanings independently for each unit;



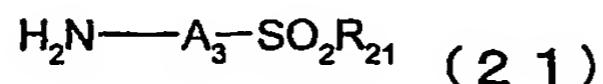
wherein R₁₉ represents hydrogen, or a group capable of forming a salt; n represents an integer selected from 0, 2, 3 and 4; m represents an integer selected from 2 - 8 in case n is 0, or an integer selected from 0 - 10 8 in case n is 2, 3 or 4; and, in case plural units are present, R₁₉, m and n have the aforementioned meanings independently for each unit.

11. A method for producing a polyhydroxyalkanoate comprising a unit represented by 15 a chemical formula (1), comprised of a step of executing a condensation reaction of a polyhydroxyalkanoate comprising a unit represented by a chemical formula (20) and an amine compound represented by a chemical formula (21):

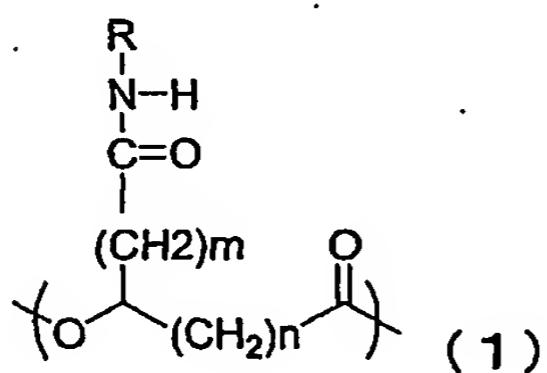


wherein R₂₀ represents hydrogen, or a group capable of

forming a salt; n represents an integer selected from 0 - 4; m represents an integer selected from 0 - 8 in case n is 0, 2, 3 or 4, or m is 0 in case n is 1; and, in case plural units are present, m and n and R₂₀ have 5 the aforementioned meanings independently for each unit;



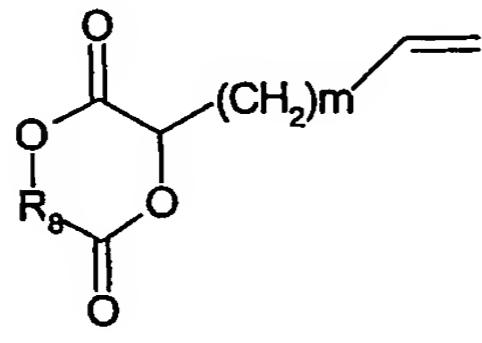
wherein R₂₁ represents OH, a halogen atom, ONa, OK or OR_{21a}; R_{21a} and A₃ each independently is selected from a 10 group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure, or a substituted or unsubstituted heterocyclic structure; and, in case plural units are present, R₂₁, R_{21a} and A₃ have the 15 aforementioned meanings independently for each unit;



wherein R represents -A₁-SO₂R₁; R₁ represents OH, a halogen atom, ONa, OK or OR_{1a}; R_{1a} and A₁ each independently represents a group having a substituted 20 or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure, or a substituted or unsubstituted heterocyclic structure; n represents an integer selected from 0 to 4; m represents an integer selected from 0 - 8 in

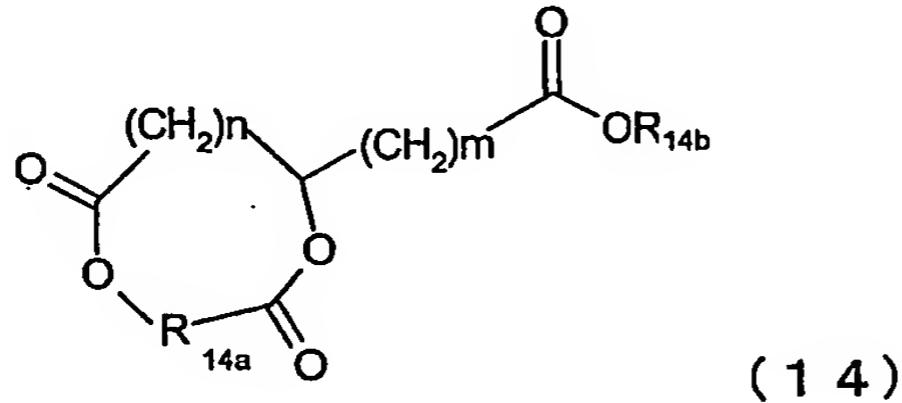
case n is 0, 2, 3 or 4, and m represents 0 in case n is 1; and in case plural units are present, R, R₁, R_{1a}, A₁, m and n have the aforementioned meanings independently for each unit.

5 12. A compound represented by a chemical formula (8) :



wherein R₈ represents a linear or branched alkylene 1 - 11 carbon atoms, or alkyleneoxyalkylene group with 10 (each alkylene group being independently with 1 - 2 carbon atoms), a linear or branched alkenyl group with 1 - 11 carbon atoms or an alkylidene group with 1 - 5 carbon atoms which is unsubstituted or substituted with an aryl group; and m represents an 15 integer selected from 2 - 8.

13. A compound represented by a chemical formula (14) :

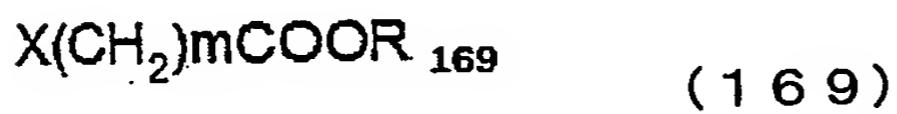
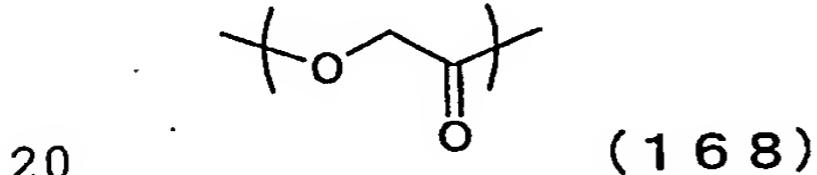


wherein R_{14a} represents a linear or branched alkylene 20 with 1 - 11 carbon atoms, alkyleneoxyalkylene group

(each alkylene group being independently with 1 - 2 carbon atoms), a linear or branched alkenyl group with 1 - 11 carbon atoms or an alkylidene group with 1 - 5 carbon atoms which is unsubstituted or 5 substituted with an aryl group; R_{14b} represents a linear or branched alkyl group with 1 - 12 carbon atoms or an aralkyl group; n represents an integer selected from 0, 2, 3 and 4; m represents an integer selected from 2 - 8 in case n is 0 and an integer 10 selected from 0 - 8 in case n is selected from 2 - 4.

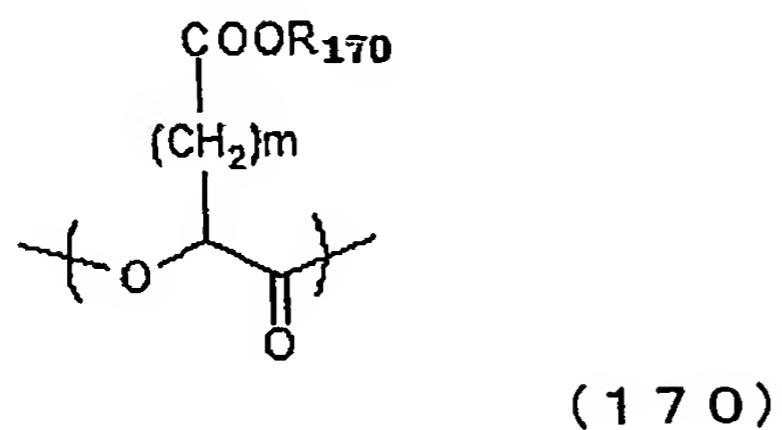
14. A method for producing a polyhydroxyalkanoate comprising a unit represented by a chemical formula (170), comprised of:

a step of reacting a polyhydroxyalkanoate 15 comprising a unit represented by a chemical formula (168) with a base; and a step of reacting a compound obtained in the aforementioned step with a compound represented by a chemical formula (169):



wherein m represents an integer selected from 0 - 8; X represents a halogen atom; and R₁₆₉ represents a linear or branched alkyl group with 1 - 12 carbon

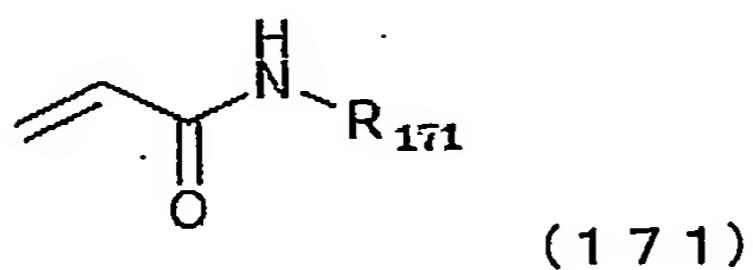
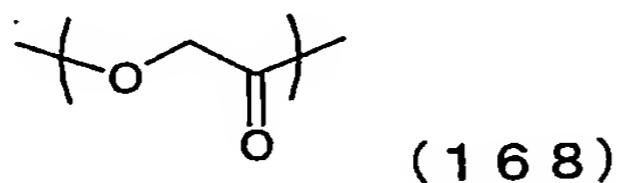
atoms or an aralkyl group:



wherein m represents an integer selected from 0 - 8; R₁₇₀ represents a linear or branched alkyl group with 5 - 1 - 12 carbon atoms or an aralkyl group; and in case plural units are present, R₁₇₀ and m have the aforementioned meanings independently for each unit.

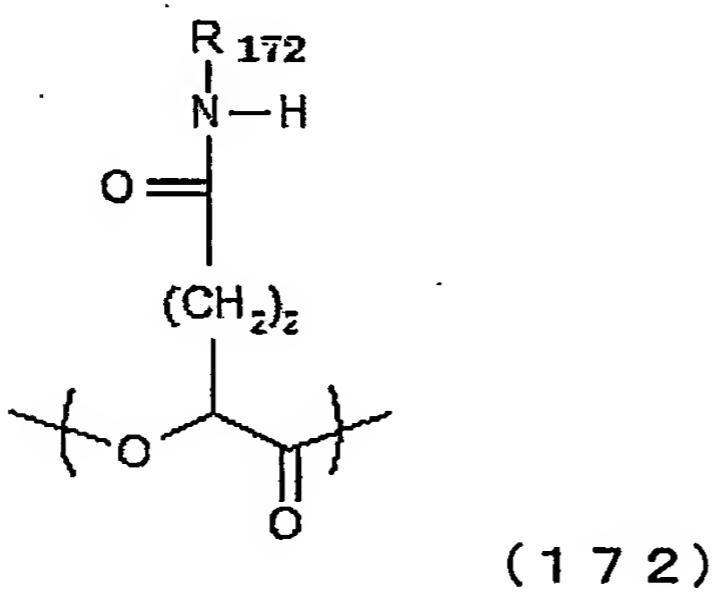
15. A method for producing a polyhydroxyalkanoate comprising a unit represented by 10 a chemical formula (172), comprised of:

- a step of reacting a polyhydroxyalkanoate comprising a unit represented by a chemical formula (168) with a base; and
- a step of reacting a compound obtained in the 15 aforementioned step with a compound represented by a chemical formula (171):



wherein R₁₇₁ represents -A₁₇₁-SO₂R_{171a}; R_{171a} represents OH, a halogen atom, ONa, OK or OR_{171b}; R_{171b} and A₁₇₁ each independently is selected from a group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure, or a substituted or unsubstituted heterocyclic structure; and in case plural units are present, R₁₇₁, R_{171a}, R_{171b}, and A₁₇₁ have the aforementioned meanings independently for each unit;

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15

wherein R₁₇₂ represents -A₁₇₂-SO₂R_{172a}; R_{172a} represents OH, a halogen atom, ONa, OK or OR_{172b}; R_{172b} and A₁₇₂ each independently represents a group having a substituted or unsubstituted aliphatic hydrocarbon structure, a substituted or unsubstituted aromatic ring structure, or a substituted or unsubstituted heterocyclic structure; and in case plural units are present, R₁₇₂, R_{172a}, R_{172b}, and A₁₇₂ have the aforementioned meanings independently for each unit.